Uncertainty in project phases: A framework for organisational change management

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Uncertainty is an integral challenge when managing organisational change projects (OCPs). Current literature highlights the importance of uncertainty; however, falls short of giving insights into the nature of uncertainty and suggestions for managing it. Specifically, no insights exist on how uncertainty develops over the different phases of OCPs. This paper presents case-based evidence on different sources of uncertainty in OCPs and how these develop over the different project phases. The results showed some surprising findings as the majority of the uncertainty did not manifest itself in the early stage of the change project but was delayed until later phases. Furthermore, the sources of uncertainty were found to be predominantly within the organisation that initiated the change project and connected to the project scope. Based on these findings, propositions for future research are defined to enable theory building in the field and resolve some of the contradictions in the literature.

Keywords: change management, uncertainty, project management

1. Introduction

Organisational change is often enabled and accelerated by globalization as advances in technology, increasingly complex multinational organizations and more frequent partnering across national and company boundaries drive the need to adapt [1], [2]. Authors such as Daft et al. [3] argue for the importance of organisational learning to *"enable the organisation to continuously experiment, improve and increase its capability"* (p.29). Organisational change is often concerned with changes in processes and operations in order to improve the competitiveness of the company. As such, it is often achieved and managed as projects. Organizational Change Projects (OCP) typically contain high levels of uncertainty as the need for change can be unpredictable, discontinuous, often triggered by crisis, and project outcomes may be unknown [4], [5]. Employees may experience uncertainty regarding their personal and/or the organisation's future [6], actual costs may vary [7] and the process of managing the change project can be disrupted by unanticipated events [8]. Change also means by definition that a company moves into a *"less well-defined future"* [9, p. 759]. Studying 1,471 change projects, Flyvbjerg & Budzier [10], found an average cost overrun of 27%, cost overruns of 200% in one in six projects and schedule overruns of 70%. Similarly, Burnes [11] estimates that somewhere between 40 -70% of change initiatives fail. Thus, uncertainty is an unavoidable corollary to change projects.

For this research, uncertainty is defined as *"a potential deficiency in any phase or activity of the process, which can be characterised as not definite, not known or not reliable"* [7, p. 683]. If uncertainty is not addressed it can have an impact on project governance and result in the neglect of issues that are related to measurement and evaluation [12]. While current literature acknowledges the need for investigating uncertainty in the context of organizational change [13], [14], major gaps prevent an in-

depth analysis of uncertainty and its impact on project outcomes. As such, current research does not define the different types of uncertainty arising from different sources such as the organisations environment. Some authors highlight the need to understand the different uncertainty types and conceptualise these according to the nature of uncertainty along a spectrum from variation to chaos [4], [8]. However, for successful management of the uncertainty and its impact on the change project, it is important to understand the source of the uncertainty such as the relationship or the change context to identify appropriate actions for mitigation [15]–[17]. Furthermore, uncertainty types are typically interconnected and there is a need to examine the nature of these interconnections [17]. Thus, analysing the different uncertainty types and their interconnections is a gap in the literature that prevents successful uncertainty management. Second, existing literature highlights the temporal dimension of uncertainty [17]. As such, uncertainty can develop during a project and is often particularly prevalent in the early stages and reduces over time [18]. However, to date no breakdown of uncertainty in the different project phases has been presented. This prevents organisations from identifying the time of suitable uncertainty management activities in change projects.

This research aims at closing this gap by answering the following research questions: RQ1: How do different sources give rise to uncertainty types in organisational change projects? RQ2: How do uncertainty types evolve over project phases? A case study is presented of an organisational change project within a large, internationally operating corporate group in the oil and gas industry. The case study focuses on the company's change project to design and implement an Enterprise Resource Planning (ERP) project that involved two of the group's companies as well as the software developer and third party consultancies. The results showed some

surprising findings as the majority of the uncertainty did not manifest itself in the early stage of the change project but was delayed until later phases. Furthermore, the sources of uncertainty were found to be predominantly within the organisation that initiated the change project and connected to the project scope. Based on these findings, propositions for future research are defined to enable theory building in the field and resolve some of the contradictions in the literature.

2. Theoretical background

This section describes the theoretical background used for the empirical investigations. First, a synopsis of the literature on change and project management is presented before the concept of uncertainty is described.

2.1 Change and project management

Organisational change is often managed through projects within companies and external experts. Organisational Change Projects (OCPs) have been differentiated in the literature according to three dimensions: rate of occurrence, level of predictability and scale [11], [19]. The rate of occurrence defines whether the change is continuous or discontinuous. Continuous change is the *"ability to change continuously in a fundamental manner to keep up with the fast-moving pace of change"* [5, p. 372]. This would thus be a regular characteristic of the organisational culture within the company. In contrast, discontinuous change are one-time events [5] and thus can contain very high levels of uncertainty as organisations move from a familiar domain into a un-defined domain [14].

The level of predictability has been linked to long discussion within the literature, an overview of which is presented by By [5] and Bamford and Forrester [14]. In general, it can be summarised that this dimensions differentiates planned and

emerging change. Planned change arises from a top-down decision within the organisation and is implemented according to a pre-planned timeframe and defined objectives [11]. This models does hence not consider the possibility and influence of uncertainty on reaching the objectives and focuses typically on small-scale, incremental change [19]. In contrast, emergent change applies a bottom-up approach where the need for change is identified to include the internal and external uncertainty in the project [14]. This approach highlights the need for the organisation to become a learning system [5]. The scale of the change project identifies the level of complexity as the change can concern the whole organisation or a department or division within [5], [19]. The underlying assumption is that change projects of high complexity have the potential for high levels of uncertainty as interconnections can create unpredictable knock-on effects [20].

In the literature, different structures of OCPs have been described. For example, Hayes [21] proposed a six-step model of change management consisting of: recognising the need for change, diagnosing what needs to be changed, planning, implementing and reviewing, and sustaining the change. In contrast, Maier et al. [22] propose four phases: planning, development, evaluation, and maintenance. A third approach was proposed by Bullock and Batten [23] and taken up by By [5] who described four phases: exploration, planning, action and integration. Despite the differences in naming the OCP phases, each of these approaches highlights the need to prepare and plan the change activities, to act on and implement the change and to evaluate and maintain the effects of the change. Uncertainty is often particularly prevalent in the early stages of projects [18], i.e. the planning, developing and implementing phases. Thus, this research will particularly focus on these phases of the change management process.

As such, change management can be viewed through the lens of systems theory as a socio-technical system [14], [24]. This approach allows investigating the links between the organisation and its environment and between the OCP and other parts of the organisation including processes and structures. As such, an OCP involves the integration between the employees within the organisation and how the change affects them and their experience of uncertainty [25] and the technical sub-system including Information Technology (IT) and administrative systems [14]. The desired outcome is a socio-technical system with balanced subsystems [24].

2.2 Uncertainty

The focus of this research is on uncertainty as opposed to project risk. In the literature, different definitions of the terms can be found [7], [26], [27]. Despite this existing argument, the terms are still often used interchangeably to describe similar problems in practice. The definitions used for the research presented in this paper are as follows. Uncertainty is defined as a potential deficiency in any phase or activity of the process which can be characterised as not definite, not known or not reliable [7]. This means that some relevant information about the outcome of a process or a decision in the future is not known or knowable. In comparison, risk is defined as the possible impact or outcome of this uncertain situation or problem [28]. As such, uncertainty is the lack of certainty in the project team's knowledge and risk is the impact of this uncertainty on project objectives. Thus, uncertainty management is key to successful project management [8]. It deals with the unknowns in a project, their causes, influences and interactions while risk management deals primarily with the management of impacts, typically categorised according to their potential negative influence [29]. In other words, uncertainty management takes a wide view to ensure project objectives are met, possible threats are mitigated and opportunities are realised [4].

In this research, uncertainty is understood as a lack of knowledge and arises in events that are *"unpredictable, ambiguous, equivocal, or lacking information"* [17, p. 478]. So far, only limited attention has been paid to uncertainty management in OCPs. Chapman & Ward [29] and Atkinson et al. [30] use the term Project Uncertainty Management (PUM), postulating that traditional project management practices do not attend to the need for flexibility and tolerance of vagueness. PUM focuses on identifying and managing the numerous sources of uncertainty. It aims to manage these uncertainties by accumulating knowledge and using reflective processes to reduce it [31]. Another purpose is to clarify the *"uncertainties that may influence the outcome of an uncertain problem or situation"* [16, p. 5]. Uncertainty is not limited to a lack of information and ambiguity but can also include characteristics of project parties and their relationship, trade-offs between trust and control mechanisms, and varying agendas in different phases of the project life cycle [30].

2.2.1 Uncertainty types

Uncertainty is a multi-layered concept it can be about the organisation, the relationship with other organisations or other features of the change context [17]. As such, different uncertainty types exists and each demand a different management approach [4], [8]. There are many different ways to classify uncertainty types. For example, De Meyer et al. [8] advocate categorizing them based on their impact, into foreseen uncertainty, unforeseen uncertainty and chaos. Another approach is to categorize them based on their sources. Most scholars agree that uncertainty can arise from sources both internal and external to the project and have suggested categories that reflect this concept [17], [31]. For example, in the context of general project management Perminova et al. [31] described the sources of uncertainty as technological, resource, competitive, supplier, consumer and political uncertainty. Similarly, Ward & Chapman [32] focused on

uncertainties that have a large influence on project management such as design and logistics, objectives and priorities as well as relationships between project parties. The current literature agrees that a project will typically display a mix of uncertainty types but lacks any insights into the nature of this mix.

A possible source of uncertainty may be the project goals, objectives, scope and priorities. Project uncertainty refers to uncertainty surrounding goals, defined by the project [30]. It is primarily related to project performance measures such as time, resources and quality and stems from the variability in estimates [7]. This variability can arise from a lack of a clarifying the specification or requirements due to the inexperience in the change project, the complexity of the project processes and involved parties, unexpected events or bias of the estimator and decision maker [30], [33]. Specifically, system complexity in terms of the number, variety and interdependence of the project stakeholders [20] can create project uncertainty. Assumptions regarding project objectives may turn out to be unjustified leading to unexpected changes in the project scope or timescales [31].

Another source of uncertainty can lie within the organisation and refer to its capability to provide or receive the service [1], [34]. Organisational uncertainty originates from outside the project boundaries yet remains within the boundaries of the organization owning the project. It is related to strategic issues, such as the future direction of the organization, and structural issues such as organizational structure, functions of the different departments, business processes and reporting [35]. Organizational uncertainty often originates from changes to the organizational structure or the introduction of new technology and therefore creates job-related uncertainty. The organisation may not have the information it needs to perform a task leading to task uncertainty [36].

Uncertainty can also arise from the project partners and the relationship between them, causing relational uncertainty. As such, the behaviour of interactional partners can be unpredictable [17]. Relational uncertainty goes beyond understanding who the relevant stakeholders are and their influence and interest in the project. According to Ward & Chapman [37] it includes the quality and reliability of partners' work. It also includes the level of goal alignment, i.e. the extent to which the parties' objectives are aligned with each other and the overall project goals. This is particularly important when dependency on the project partners for project success is high. It includes the trust in the partners' reliability to fulfil promises and deliver in time to the agreed level of quality.

A fourth source of uncertainty may be the environment of the organisation leading to *"the state of a person who perceives himself/herself to be lacking critical information about the environment"* [38, p. 134]. It includes uncertainty related to legal or market trends that may influence the project. It also includes uncertainty about the choice of technology and the suitability of technical infrastructure. Influences can come from issues such as the technological development on the market leading to the possibility of obsolescence of the product or parts [39] and thus unavailability for service activities. Similarly, the availability of material, parts and tools necessary to perform the service activities may be uncertain in terms of quantity and/or timing of supply [40].

2.2.2 Uncertainty in project phases

Different types of uncertainty affect different phases of the project life cycle (PLC) and similarly, the level of uncertainty is influenced by the phases of the PLC [30]. Uncertainty has been highlighted as especially important in the earliest project phases [18]. In principle, during the exploration phase of the PLC much of the uncertainty is

removed by specifying some fundamental parameters such as cost and project timeline, and by specifying resources and responsibilities. However, much of this uncertainty may remain unresolved until later project phases or even the end of the project [37]. Atkinson et al. [30] identified uncertainty management issues that commonly occur in the PLC phases. Their work suggests that in the early project phases uncertainties are typically connected to the lacking ability to define project goals and performance objectives, while later phases may be prone to uncertainty project partners including contractual terms. However, to date no investigation regarding the uncertainty types that occur in different change project phases exist.

3. Research method

To investigate the research questions, this paper presents evidence from a single case study. This caused obvious issues of generalizability; however, the case-study approach is suitable for this research due to the following reasons. Yin [41] states that case studies are an appropriate research method to use when the research question focuses mainly on ‘how’ or ‘why’ and are more explanatory or exploratory in nature. Research in change management and specifically on uncertainty in OCPs has been described as lacking empirical investigations and needing exploratory studies [14]. In addition, current theories in the field tend to give contradicting suggestions [5], which highlights the need for exploratory and explanatory research. Second, the contingent nature of OCPs has been highlighted as organisations differ and face different variables in their change process [5]. The single-case method offers a suitable approach to study a phenomenon within its empirical context [42]. Third, uncertainty is a multi-layered concept [16], [17] and the case approach allows for iterative inclusion of current theoretical understanding and the empirical insights to ensure validity of the findings [41]. An in-depth discussion of an exemplar case allows us to identify the empirical

evidence needed to improve understanding (Siggelkow, 2007). As such, the case method has been highlighted as a useful approach to investigate change [25].

3.1 Case study

The case selected for this research was an Enterprise Resource Planning (ERP) Implementation Project in a large, internationally operating corporate group in the oil and gas industry. This particular case was selected for several reasons. Firstly, the project involved socio-technical change which implies that it is not purely a change of tasks and technology but also involves changes to social systems, i.e. people and structure. Secondly, the project involves several parties with many interdependencies between them. The complexity seen in this project was deemed representative of a typical case which improves the applicability of the developed insights to other cases (Yin 2009). Finally, practical considerations were also taken into consideration as one of the authors had been closely involved in the project in the role of student assistant.

The case study focuses on the company's change project to design and implement an Enterprise Resource Planning (ERP) project that involved two of the group's companies as well as the software developer and third party consultancies. Due to confidentiality reasons, the group's two companies will be referred to as Clients 1 and 2. Clients 1 and 2 were treated as embedded units within the project as they represent two separate business units or organizations in the group. This analyses focused on the initial part of the project consisting of designing and implementing a suitable ERP system within the two companies. At a later stage, it was further planned to roll-out the system to the whole group. However, due to the (assumed) high level of uncertainty in the early stages of change projects this research focuses on these early stages of the project. This part of the project was divided into the following project phases: Initiate, Confirm & Specify, Establish, Implement and Go-live. The research

focuses on the first four phases of the project. Table 1 depicts the main content of these four phases.

<Please insert Table 1 about here>

3.2 Data collection

The unit of analysis was the change project. The empirical data were collected over a two-month period and included multiple sources of evidence (Yin 2009). Sixteen semi-structured interviews were conducted, each lasting approximately one hour. The interviewees were chosen based on their direct involvement in the project and were affiliated with the three main project parties – Clients 1 and 2 and the Software developer. Table 2 depicts the list of interviewees for this case. The interviews started with the Programme managers of the two Client companies who identified suitable other interview parties to cover all important and relevant areas of the case. Using the snowball method of sampling ensured that all relevant parties were interviewed and included in the data collection.

<Please insert Table 2 about here>

An interview guide was used to ensure that the important topics were covered with each interviewee. The interview guide was modified at a later stage to go into further detail on a particular topic of interest with specific interviewees. Each interview was recorded and transcribed. To ensure validity, an interview summary was written and verified with each of the interviewee. Possible verifications, amendments or comments were incorporated into the data collection. Interview questions were designed to identify and elicit when, where, why and how uncertainties had occurred in the project. A secondary goal was to investigate the effects of the uncertainty and understand whether it was ultimately resolved and if so, how. The interviews guide aimed at retrospectively

covering the ERP project in chronological order through the four project phases of Initiate, Confirm & Specify, Establish, Implement.

Secondary data was collected to ensure validity and reliability of the findings. Published materials such as the corporate group's News magazine and other online articles written for employees were collected and analysed. These publications were the main form of communication from the project to its end-users and included articles reiterating why the ERP project was needed, status and progress reports. Supporting documents from the project SharePoint site such as the Project Definition Document, the Scope Document, meeting minutes, presentations and email announcements were collected and used to validate and supplement data from the interviews.

3.3 Data analysis

The interview transcripts and secondary data were coded in a multi-stage process supported by the qualitative data analysis tool NVivo. Initially, the coding consisted of content analysis focusing on terms indicating uncertainty in the interviewee. This approach was introduced by Kreye [43] and was developed based on the literature in the field. The approach utilised 53 terms indicating uncertainty as depicted in Table 3. In the next phase, clusters of these terms were identified and coded to identify emerging themes of uncertainty. Coding was iterated several times and new ideas or emerging themes were coded accordingly. The software supported this process by allowing the plotting of codes along the project phases and creation of meta-codes. The themes were also re-combined as patterns emerged. These descriptions were then plotted across a timeline to describe each instance of uncertainty to construct influence diagrams which demonstrated how the uncertainty evolved across the project phases. The use of influence diagrams to model uncertainty allows the researcher to identify potential important sources that are directly and indirectly linked to the researched phenomenon

[37]. Travelling back and forth between the empirical data and the literature facilitated theory building.

4. Findings

In this section, the case findings are introduced with regard to the identified themes where uncertainty was important. These themes were the technical and project requirements, project planning, staff management and rotation, and processes in organisations and relationships. These descriptions will be preceded by and introduction of the purpose of the system and concludes with some thoughts on the performance of the change project.

4.1 Purpose of system

The purpose of the new system was to consolidate the various individual systems within Clients 1 and 2 including finance, procurement and operation as the Project leader summarised: *"for most people both in finance and operations many things are going to move from various scattered systems into [the ERP system]."* The Leader of O&M ERP elaborated: *"What we wanted initially was to get a tool that could combine a lot of input for us so that we could have an overview to see where we might get bottlenecks and overloads into our working routine."* Thus, the change project will have substantial effects on the organisational processes and procedures within Clients 1 and 2. The Leader O&M ERP explained: *"it is something completely new; it will introduce a completely new way of working to what we have today. So from a change management point of view, in terms of the impact on people it will be some of the things that will make the biggest difference."* The project manager (Client 2) agreed with this assessment: *"ERP will change a lot. It will change our business processes, it will change the way we work in the future."* The Programme manager (Client 1) concluded

this description: *"[This] means there is so much uncertainty."*

4.2 Technical and project requirements

The project requirements were defined before the project start by a small team within the Clients' organisation. The Programme manager (Client 1) explained: *"no-one, or at least very, very few in the organization understood anything about ERP."* The people involved in defining the project requirements had not had enough experience with the topic as the Implementation manager summarised: *"people put as a requirement not knowing what the ERP can actually bring to the table."* This initial process resulted in a list of requirements – *"it was about 1,667 requirements [we] had"* (Project manager, Client 2). These requirements were used to choose the Software developer and define their contribution to the project. The Project manager (Client 2) explained the intentions: *"they had to deliver these 1600 requirements. When the project is finished, (…) we need to check that we have received all these. That is the contractual requirements."* The Sr project manager 2 (Software developer) described the requirements as follows: *"A lot of the requirements were quite similar to what we have seen before. (…) when comparing the list from [the Client] with [an existing list of a different project], we realized that it was 80% the same."* The level of uniqueness of the ERP system seemed hence relatively low.

The parties thus decided to go for a standard solution of the Software developer and incorporate the customisations. The requirement list defined the central basis for the project's deliverables throughout all phases as the Sr Project manager 1 (Software developer) explained: *"These requirements stand. It is very difficult to change."* However, as the project progresses the project parties realised the shortcomings of the initial list of requirements and agreed that some changes needed to be made as the Leader O&M ERP highlighted: *"we had to expand the scope"* due to the fact that "there

are new requirements on top of the old but replacing them is not really possible" (Sr. Project manager 1, Software developer). The Leader O&M ERP explained the reason for this scope increase: *"when people came in who had been working offshore and who had been the users of the system, they looked at the requirements and said ' if we do this, it also makes sense that we include this.'"* The Software developer attributed this to the lack of prior experience of the Client with a similar project as the Sr. Project manager 2 (Software developer) explained:

> *"More mature customers know that things will change. So those requirements that were written three years back based on how they operated their current system might not be the right basis to make decisions on. Things do change, and a project like this is also about learning and evolving."*

The difficulty to predict all requirements prior to the project also arose from the complexity of the technical solution. Financial solutions explained: *"making one change, there is a domino effect. So even though it is configurable and manageable internally, so many things can make a change to it that you don't know what the impact of that change is."* Due to their experience with similar projects, the Sr Project manager 2 (Software developer) suggested a different management approach to account for the uncertainty: *"we don't want the requirements carved in stone; we should be able to change that as we go along to find the best solution in an iterative process. But [Clients 1 and 2] are quite the opposite."*

The level and extend of changes had significant impacts on the contract as *"we come very often into some of these grey zones"* (Programme manager, Client 1). The Sr project manager 1 (Software developer) explained the process: *"There is typically a change request [where the Client says] 'We have come across this new additional requirement that we didn't think of to begin with and we [included it in the list]'."* This

situation would result in contract renegotiations. This often caused problems as the Programme manager (Client 1) highlighted:

> *"This creates the situation where we sometimes have [the Software developer] stating that 'this was not part of the original scope' and from the [Client] side people are saying 'that is part of the original scope!' When we look into the requirements, to some extent it is perhaps mentioned but not to the detailed level."*

Fixating on this initial requirements list for very long caused some delayed decisions as the Sr. Project manager (Software developer) exemplified for the operations and maintenance part of the software solution:: *"we found out late last year that to go for [the standard solution] was the wrong decision. To begin with it seemed right, adding a little [but adding] a lot more meant that we cannot recommend going that way."* Thus, using a fixed set of requirements throughout the change project caused various issues in the relationship between the project parties and ultimately delays in the overall project.

4.3 Project planning

The issues with the technical and project requirements had strong impacts on the resource planning for this project. *"[The original] idea was that we are going to save 10 – 20% by doing both [Clients] at the same time"* (Financial solutions). Based on the original set of requirements, a plan was comprised by the individual teams responsible for different aspects of the change project. The Implementation manager describes the reasoning: *"It is a good idea on paper because the people who are actually working with the solution, they understand it better and they know how much time certain things would take."* However, the problem was the lack of experience as the Implementation manager continued his explanation: *"for most of the people it is the first project. So they don't have experience and they can't sometimes estimate how long certain things will take. They don't foresee the process."* Due to the de-centralised process and lack of

prior experience of the people responsible for planning, *"the plan was not realistic to start with"* (Project manager, Client 1). The reason was the nature of the change project, as the Project manager (Client 1) continued his explanation: *"the planning is so difficult, doing it based on something that you haven't actually done and you don't really know enough about."* This led to a mismatch between plan and actual needs of the project as the Finance Business Reference Group Lead summarised: *"originally the scope and complexity of the finance [processes] was completely underestimated. (…) we had misunderstood what would be required from Finance perspective to ensure that the project reaches fulfilment."*

Due to the insufficient initial plan and the increase in technical requirements and project scope, the amount of project activities increased. The Finance Business Reference Group Lead explained: *"It is far more than we expected that they would need to do."* The Programme manager (Client 1) elaborated: *"we could see that the project timeline changed a great deal because in a number of areas things became more complicated than we expected at that time."* Despite the acknowledgement of changes in the project timeline, the Client did not update the project plan sufficiently as the IT consultant described: *"we are pushing things in front of us and then we re-plan, within very limited timelines."* The lack of implementing the changes in the project timeline impacted the individuals' workloads as the Leader O&M ERP highlighted *"things take longer than people think and then you have suddenly three things running in parallel which is not ideal."* Furthermore, *"we had to hire more people, then we had to rework things over and over again"* (Financial solution). The issue of staff workload is further elaborated in Section 4.4.

4.4 Staff management and rotation

The project was characterised by high levels of complexity as 120 members of staff

worked on it. This was represented in the project structure as the IT consultant described:

> *"normally we have one programme manager, who can have ten project managers, who can have a lot of team leads. Here we have two programme managers, two project managers and a lot of teams. And then we have two steering groups and two reference groups."*

The people working on the project experienced many problems as the ERP Project Cost Controller explained: *"It was like 'here are the keys, there is the car and go drive.' And I don't have a driver's license!"* Staff planning was done by the Software developer as *"[they] had an idea about how many people they would need and how long it would take"* (Implementation manager). Problems arose in terms of staff management causing project delays as the Financial solutions explained: *"They [the solutions provider] didn't understand the complexity. Even though I was very clear from the beginning, and argued 'well this is what you are going to run into' and they said 'oh no, we can do it'."*

The project had continuous problems of being understaffed as the Implementation manager highlighted: *"[The resource plan] didn't match the reality in the end and it took a while to get to the point where we had enough people doing the work."* The reason for this was *"that the complexity and the scope of [the project] have been underestimated"* (Finance Business Reference Group Lead). Particularly, the level of change in the requirements increased the workload which meant that *"a lot of people are putting in more than 70 hours per week continuously"* (Finance Business Reference Group Lead). This in turn caused staff drop-outs as the Programme manager (Client 2) elaborated: *"We have had issues with fatigue. I know two [Software developer] consultants have had to just leave for a month; we have seen indication of our own resources also being close to fatigue."*

Another issue was to find people who had the appropriate level of experience in IT and organisational processes within both Client organisations to support the ERP project. The Implementation manager explained: *"the first six months we were really struggling with not having enough people to support us, and not having the right people. We had people who didn't have enough knowledge or experience."* The project had high levels of staff rotation where the Software developer *"would pull somebody in or out"* (Financial solutions). The Project manager (Client 2) suggested reasons for this observation: *"It can be work environment, it can be internal misalignments, it can be the new organization where people say, fine with me they want to change the organization but I am not going to be a part of it."* Staff rotation caused further delays on the project as the Implementation manager described: *"The handover was not a strong point of [the Software developer]. So every new person who came (…) we had to spend 2 weeks trying to explain exactly what we are trying to achieve."*

4.5 Processes in organisations and relationships

The project parties had not worked together before engaging in the ERP project. The Programme manager (Client 1) summarised the situation: *"we are taking 120 people, most of them have never worked together before. You put them into one company and now they have to align and start working together and they have to deliver a solution that is by the way not that well defined yet."* The project parties acknowledged the need to understand each other; however, there was a mismatch in what the parties brought to the project. The Clients brought the list of technical requirements to the negotiations; however, *"it was not clear in their minds and therefore they couldn't explain what they wanted"* (Sr project manager 2, Software developer). In addition, Client 2 did not have any formal business processes that could be represented in the future ERP system. The Project manager (Client 2) explained: *"we did not have any mapping whatsoever of*

business processes." This caused difficulties for the Software developer as the Sr Project manager 2 highlighted: "*we don't know [Client 1] to begin with. They have some understanding of their own business but not really everything, and almost no knowledge about [our] solution. And when you communicate like that, it is actually very difficult."* This in turn caused the Clients to be unsatisfied as the Finance Business Reference Group Lead described: *"there was a mismatch in the knowledge levels we would have expected from [the Software developer's] consultants. That caused a great deal of challenges and misunderstandings to begin with."*

The parties started building this understanding of each other, of the technical solution (by Clients 1 and 2) and of the Clients' business processes (Software developer) on a trial-and-error basis. This process was very frustrating for the project parties as expectations were not fulfilled as the Finance Business Reference Group Lead stated: *"It was very difficult, we spent a lot of time discussing what was possible, what was not possible."* The Leader O&M ERP elaborated: *"it has been a number of months where there have been a number of defects where they delivered something that hadn't lived up to what we expected."* One of the main challenges was communications between the project parties as the Leader O&M ERP continued: *"[the Software developer] talking very much in a system kind of way, we are talking about business processes."* The Leader O&M ERP summarised: *"[the Software developer] wasn't sufficient to meet our requirements. And it has been a very long and cumbersome process."* However, the blame could be given to both sides as the IT Consultant stated: *"[the Clients] have not been very good at stating what they wanted in the first place, then they got it and they said this is not what I wanted. And then claiming bad quality from [the Software developer]."*

The governance structure of the ERP project was different from the Clients' usual process. The Clients' usual approach was to "a vendor of the ERP solution, then you would have an implementation partner, and you would usually also have a partner giving advice on what you are doing" (Business Solution Architect). However, in this project a different approach was followed as the Business Solution Architect continued: "*we have not been doing so in this project. We have had the implementation partner, being [the Software developer] and [they are] the implementation partner. (…) [Thus] we have not been challenging the [Software developer's] resources as we should."* This in turn created further uncertainty in the relationship, specifically the trust in each other's intentions and capabilities.

4.6 Performance

The performance of the project deliverables was expected to vary across the different sub-systems of the software solution. This resulted in reduced performance expectations for some sub-systems as the Project manager (Client 2) outlined his expectations for the project performance: The Leader of O&M ERP explained *"This has now got very delayed. The latest forecast we have now got in terms of when they can deliver a final product will collide with our current go-live dates. So we need to prepare for a second roll out."* In addition, the project cost had increased as Financial solutions outlined: *"we probably have spent 10 – 20% more."* The Sr project manager 1 (Software provider) summarised the performance as follows: *"with a lot of creativity within the teams we have actually managed to fulfil a majority of the requirements. And I am pretty satisfied with the outcome we have made so far*." Thus, the expectations on the project deliverables had been reduced. The Project manager (Client 2) outlined this: *"[we have to] sometimes accept we can't make everything 100%, maybe some times 80% is ok to accommodate what we are strategically going for."* This reduced level of

deliverables gave some advantages as the Leader O&M ERP explained:

> *"[when] we have the basics, let's do the roll out and let people get familiarized with [the system]. And once they have some months of experience and have grown a bit more comfortable in using it, then we can add on with this new more advanced functionality."*

5. Discussion

This section presents the insights from the case study in light of the literature in the field. The section is structured to answer the research question.

5.1 Uncertainty in change projects

The case confirmed the importance of investigating uncertainty in projects as the Sr Project manager (Software developer) stated: *"I don't expect that there are significant impacts at this point in time. But you can say it adds stress and confusion to the project."* The described project confirmed insights in the literature that uncertainty can be caused by *"inability to evaluate the effects of actions because too many variables interact (complexity)"* [4, p. 1009]. The level of complexity in the presented project was underestimated, causing the level of uncertainty to be underestimated and thus not be included in the planning activities appropriately. No judgment of information adequacy [4] was undertaken at the project outset. The case showed that if uncertainty is not addressed in the change project, it can impact project governance and result in delays and quality issues [12].

The uncertainty was connected to different sources. One source that established itself early in the project and subsequently impacted the other uncertainty types was organisational uncertainty, i.e. the insufficient capabilities [1] of the Clients when defining the project requirements. Specifically, the findings suggest that the Clients did not have the information they needed to perform the change task [44]. The lack of the

Clients to acknowledge these issues supported the observation by De Meyer et al. [8] that *"managers consistently failed to recognize that there are different types of uncertainty"* (p.60). The Clients' lack of understanding the insufficiency of their own capabilities for this change project caused an insufficiently adapted management style [45] and the rise of further uncertainties throughout the project.

Throughout the project, project uncertainty was the most prevalent source of uncertainty. This was related to the change of technical requirements and thus increased project scope, the underestimation of the workload in the project, the rotation of project staff and resulting delays and reduced quality of the final expected deliverable. The project parties were forced to accept the high level of uncertainty and thus increase the level of flexibility as suggested by the literature [4], [34], [46]. The project's uncertainty profile would compare to what Pich et al. [4] call "unforeseen uncertainty", i.e. issues that were not *"identified during project planning"* (p.62). One way to deal with this high level of project uncertainty could be to *"mobilize new partners in the network who can help solve new challenges"* [4, p. 63]. The project partners acknowledged this as exemplified by the Programme manager (Client 2): *"it would probably have been better to introduce [Software developer] at an earlier stage. (…) I think if we had had some introduction and education with [the Software developer], we would have had better quality and maybe more progress."*

The increasing amount of changes to the project scope, project delays and inadequacies in the quality gave rise to relational uncertainty between the Clients and the Software developer. This was due to the fact that the project was governed based on a contractual arrangement that included the initial set of 1,667 requirements of the ERP system. The increasing changes to these requirements caused timely re-negotiations of the contract as well as discussions on liability of project deliverables of insufficient

quality. The relational uncertainty was introduced at a very early stage as the Implementation manager explained: *"The planning was actually happening on both sides and in each team. That was probably one of the biggest challenges in this project overall, regardless of the solution."* One of the reasons was the lacking trust and lack of prior engagement between the project partners as the Programme manager (Client 1) argued: *"People are not used very well to working across departments. That's another matter which creates some uncertainty."*

A surprising finding was the lack of environmental uncertainty. The literature suggests that the environment is the prevalent source of uncertainty in projects [4], [13], [17], [38]–[40]; however, for this project, no such instances were observed. Instead, organisational uncertainty in the form of lacking capabilities and specifically the lack of recognising this uncertainty at the outset of the change project gave rise to project uncertainty and subsequently to relational uncertainty over the different project phases. Previous research found that external factors *"initiated, facilitated and hampered the change processes at different moments in time"* [14, p. 553] and are thus beyond the immediate control of managers. As such, it may be more important for managers to make decisions in response to environmental uncertainty and the ability of the case companies to do so might be a reason for the lack of observation.

5.2 Phases

The organisational phases followed a planned change project which has been criticised to not allow for uncertainty changing the development of the project due to assumptions of constant conditions for change [5], [14]. OCPs are by definition open ended [11] meaning that the project schedule needs to be flexible and adaptable. The lack of the case company to acknowledge this issue caused uncertainty to be carried through the project phases until it manifested itself in project delays and quality. The project phases

defined in the presented case followed the suggestions by Bullock and Batten [23] and By [5] of exploring, planning, acting and integrating the change.

The Implementation manager explained: "we spent three or four months last year during the Establish phase (…) and then at the end of this [the Software developer] said 'this is not going to work, we have to scrap this and work from the beginning'." The Finance Business Reference Group Lead concluded: "we had to go back and forth a couple of times but I think now finally we have a solution for that."

As the project progressed through the different phases, the different sources of uncertainty impacted the advancement. *"Most of the phases have been influenced by a lack of knowledge"* (Programme manager, Client 1). In the Initiate phase, the requirements were defined for both Clients. The uncertainty at this stage was mainly of organisational nature and arose due to two facts. First, Client 2 lacked formal business processes which were needed to define the requirements of the ERP system. Second, the lack of experience with ERP systems of the personnel chosen to define the requirements caused the need to re-define and change requirements at a later stage. However, at this stage the project participants did not acknowledge the level of uncertainty and proceeded with the project without resolving it through e.g. incorporating external capabilities into the decision-making process [4].

In the Confirm & Specify phase, the un-resolved uncertainty started to manifest itself and the project participants noticed its impact on the project. Once the Software developer was involved in the project, the design of the technical solution started based on the initial requirements. The Programme manager (Client 1) recalled: *"one of the things we concluded from the Confirm & Specify phase was that the detail plan was not detailed enough so we had different issues."* This realisation to change requirements came late as the Clients lacked knowledge about the technical system and the Software

developer lacked sufficient knowledge about the Clients' business processes. The Sr Project manager (Software developer) explained: *"Usually we would have a quite firm idea of what we need. During Confirm & Specify we should be more and more specific on what it is that we need. And at the [milestone after Confirm & Specify] we should have overall specifications on everything."* The changes and increasing project scope caused issues in staff management and ultimately project delays. Despite this, the project passed the milestone at the end of the Confirm & Specify phase; however, various unresolved issues were taken to the next project phase as "unresolved issues". Project control recalled: *"I still have eight or nine left from the Confirm & Specify phase that are still unresolved."*

The uncertainty carried forward from the Confirm & Specify phase manifested itself in the Establish phase as first deviations from the project schedule became apparent due to the insufficient status of the project deliverables. The Sr project manager 1 (Software developer) recalled: *"It actually introduced changes to the main process document that we had to incorporate at the last possible moment."* Thus project milestones were moved. Increased frequency of change requests meant that the project scope increased, leading to an increased need of resources and further rotations of staff within the project. This in turn led to further delays in the project deliverables. Despite this, the milestone passed and the project moved into the Implement phase. Thus, the project parties did not manage the uncertainty in the ERP project as suggested by Pich et al. [4] *"to determine project continuation when milestones are met that eliminate important ambiguities or knowledge gaps"* (p.1010). As such, uncertainty regarding project deliverables and the project timeline were again carried forward into the following phase. Financial solutions agreed with this assessment in hindsight: "We

should have had more time to actually work on getting a right solution, whereas that ended up being pushed through just to get a quality gate done."

The Implement phase was characterised by the first realisation of the uncertainty carried through the milestones of previous project phases. As such, project delays and the lack of deliverables from the ERP system were first realised causing the project timeline to be extended. Furthermore, the project parties realised their lack of understanding the effect of the scope increase. Thus, a lot of the uncertainty of the ERP project manifested itself in this phase. As such, the presented findings offered surprising insights as the uncertainty did not reduce over the duration of the project but was carried through until it manifested itself in later project phases. This contradicts typical assumptions in the literature [18], [37]. Table 3 depicts the development of the different sources of uncertainty across the studied project phases.

<Please insert Table 3 about here>

5.3 Future research

Despite the obvious issue of the single-case approach for generalizability, the presented research offers multiple suggestions for future research to further theory building in the area of change management. The results suggest that certain sources of uncertainty tend to be more important for managing change projects than others. As such, project managers should focus their management efforts on specific uncertainty types. In the presented case, these types were organisational, project and relational uncertainty. The relative importance of these types can vary depending on issues such as project complexity, number of involved project parties and level of prior competence of the leading organisation. As such, it is suggested that environmental uncertainty is an important influence on recognising the need for change and change programme management [14]; however, within a change project other uncertainty types are more

important. We, thus, propose the following.

> **Proposition 1: During change projects, uncertainty arising from sources within the project, the organisation and the relationship between project parties is prevalent.**

Uncertainty in projects is typically assumed to reduce with time leading to later project phases being less uncertain than early ones [18]. However, the presented case showed that time is not the only constraint in resolving uncertainty, some uncertainty types need to be addressed through active uncertainty management and creating flexibility in the project plan. This further supports the suggestions on the importance of project uncertainty management [29], [30] and leads to the following proposition:

> **Proposition 2: Uncertainty may not resolve itself in change projects but needs to be actively addressed and managed by the project parties.**

Arising from this need to manage uncertainty actively is the possibility of delaying uncertainty to later project phases. This phenomenon was observed in the presented case. Currently, there are no suggestions in the literature and it is suggested to spend further efforts here to understand this phenomenon in more depth. As such, the following proposition is defined:

> **Proposition 3: Uncertainty can be delayed when it is not addresses and resolved in a change project to manifest itself in later phases.**

When uncertainty is not addressed by project management, it can cause various effects on the change project. As such, the case showed that unresolved uncertainty can impact project governance and result in delays and quality issues [12]. However, further work needs to address the causal relations between different uncertainty types, the time of their manifestation and their impact on project outcomes and management. Thus, the following proposition is presented:

Proposition 4: The effects of unresolved uncertainty can be multifaceted and include project delays, insufficient quality of the deliverables and overloading of staff causing stress and fatigue.

6. Conclusions

This paper presented an in-depth discussion of different uncertainty types across the phases of an organisational change project. Based on a single-case approach, some surprising findings were presented. Despite the nature of the single-case method, some suggestions for the general nature of uncertainty in change projects were generalised. These propositions can lead future research investigations to advance the field of change management and advance theory building in the field. As such, this paper contributes to the literature by offering a framework of the development of uncertainty types over project phases. The in-depth discussion advances the understanding of the nature and impact of uncertainty in change project and closes important gaps in the literature. This enhances the literature on organisational change management and will offer a basis for future suggestions on managing these uncertainty types.

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Tables and Figures

Table 1: The project phases and main activities in ERP project

Project phase	**Initiate**	**Confirm & specify**	**Establish**	**Implement**
Duration	2 months	7 months	10 months	3 months
Main activities	Define, plan and establish project	Prepare and document solution scope Review and approve solution scope Specify data standards, migration, technical platform, integrations and configuration	Establish technical platform Establish and configure environments Perform test migration Application Solution Test to validate and test the solution Prepare training and cut-over	Train super-users and end-users Customer Solution Test where end-users validate the solution Perform cut-over and go-live tests
Result	Project launched	Solution definition approved	Solution verified	No formal milestone

Table 2: Case interviewees

Project party	**Interviewees**
Corporate group (Affiliation with both Clients 1 and 2)	Project leader Project Management Organisation (PMO) Leader IT consultant Financial Solutions manager
Client 1	Programme manager Project manager Finance Business Reference Group Lead Operations and Maintenance (O&M) Leader Business Solution Architect ERP project cost controller Implementation manager
Client 2	Programme manager Project manager Data manager
Software developer	Senior Project manager 1 Senior Project manager 2

Table 3: Sources of uncertainty across project phases

Project phase	**Initiate**	**Confirm & specify**	**Establish**	**Implement**
Project uncertainty	Insufficient definition and detail on technical requirements	Design of technical solution based on initial requirements Concerns about requirement list Acceptance of need to change requirements, agreement on procedure for change requests Staff rotations causing lack of continuity in project	List of "unresolved issues" carried forward from Confirm & Specify phase Quality concerns over final ERP system, rejection of standard solution as possibility. Agreement of new system used as basis for the ERP system. First deviations from project schedule due to insufficient status of project deliverables; movement of project milestones Deviations from project plan, increased frequency of change requests Increase in project resources due to increased project scope Staff rotations within project team Some project activities postponed to next phase	Realisation of project delay Realisation of lacks in deliverables in ERP system. Lack of understanding effect of scope increase
Organisational uncertainty	Insufficient experience and knowledge about ERP systems by Clients 1 and 2 staff Lack of formal business processes of Client 2.		Start of discussions on future impacts of ERP system, e.g. maintenance (Clients 1 and 2)	Uncertainty regarding future roles of some staff within Clients 1 and 2's organisations.
Relational uncertainty between project partners	Software developer not involved yet	Insufficient knowledge of customer processes by Software developer, Insufficient knowledge about technical solutions by Clients 1 and 2 Frustration with all project parties due to misaligned expectations and development of solution requirements Project governance initially based on	Realisations of mis-match between project parties' expectations and assumptions Start discussions about liability	Unclear definition of project parties' responsibilities

		original requirement list, later based on change requests and contract re-negotiations		
Environment	None observed	None observed	None observed	None observed